TROPICAL AGRICULTURE

THE OFFICIAL JOURNAL OF THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE

VOL. I No. 3. TRINIDAD, MARCH, 1924. PRICE 6d.

CONTENTS.

	PAGE.
Growth and Competition	33
Plantation Palm Oil	34
Jamaica Conference	39
The Tropical World	40
The Training of Managers	42
Tropical Forestry	43
Recent Chemical Research	44
Research in Biology	45
Rockefeller Foundation	46
Empire Cotton	47
College News	47
Notes of Interest	47
Trend of the Markets	48

TROPICAL AGRICULTURE is published at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, West Indies, at the end of the third week of the month preceding the one of issue. Advertisement rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E.C., England. The Editor will be glad to consider authoritative articles for publication. Correspondence is invited on all matters pertaining to tropical agriculture, science and development, which will be replied to, but not necessarily published.

GROWTH AND COMPETITION.

No field of human activity is more difficult to define than so-called agriculture, chiefly because the etymological and traditional senses of the term do not satisfy its real significance under modern conditions. "The ploughman homeward plods his weary way" of Gray's Elegy no longer fits even the English countryside: he rides a motor-bike. The old plantation songs of the Southern States, delightful as they are, no longer give a picture of conditions in the cotton fields—even the theme of those songs has been plagiarized to satisfy modern developments in dancing. The truly rural idea is fast disappearing; agriculture at any rate in America and the tropics has become wedded to commerce or manufacture with consequent multiplication of points of view and consequent impossibility of deciding where one thing ends and another begins. Is the operation of a sugar factory or the fermentation of tobacco or the curing of rubber or the shipping of coffee agriculture? According to the mediaeval sense of the term no, yet to-day they are regarded as inseparable from agriculture for they come under the same general administration and constitute what we term in the tropics agricultural industry. Still we must look for some boundary line, and if anything characterizes agricultural production, manufacture and distribution it is the fact that we are dealing with life and the products of life, and that means that our problems are mainly connected with growth and competition. There is the growth of the plant and the competition which results from many plants being grown together; there is the growth of the animal and the competition resulting from the segregation of animals; the growth of what we call parasites whose successful competition produces disease; there is growth in the numbers of men with consequent competition to control the growth of plants and animals to supply them with food and raw materials; and lastly, what is equally important there is the growth of men's ideas with the consequent development of new inventions, new wants and new ideals and fresh human competitions. The beginning and the end of it all is reproduction and death; reproduction and death in the biological sense; reproduction and death in the psycho-economic and mechanical sense. The manifestations are adaptations, change, contests, collapses, revivals, optimism, pessimism, disease and all that goes to make up history. The fundamental phenomena are variation and variability. Because of this agriculture and agricultural industry and commerce cannot broadly speaking be learnt by text. The most we can hope to do is to study principles and to keep a finger on the pulse of tendencies and be prepared to change as circumstances demand. How true this is can be seen in the history of cotton. The growth and constitution of no other plant has received so much individual attention as cotton, nor has better progress been made in regard to understanding the laws of growth and of controlling ecological conditions. In regard to plant breeding new types have been isolated with highly specialised characteristics so that nowadays the cotton plant grown under irrigation and supervision is little less than a perfect machine —if it were not for competition and changes. The pink boll worm, in nature, has as much right to live and multiply as any other organism, and the extraordinary success which can be achieved by insects in this way is seen in the case of the boll weevil of cotton in the United States. Man's ideas and numbers have also grown and have indeed been responsible for the extension of cotton production. The development of the Lancashire industry apart from the inventions of Arkwright and Hargraves was vastly

influenced by the French Revolution which altered the industrial outlook and so weakened France which was the world's chief manufacturing country, so that England became able to monopolize the supplies which later, as the result of the discovery of America and the invention of the saw-gin by Whitney were to come in such vast quantities from the Southern States. Subsequently also competition in the form of the United States Civil War reduced cotton production in that country but stimulated great though temporary extensions in Egypt and India. Now most producing countries are using their own supplies to a greater and greater extent, new areas for production are being exploited and new problems are arising in respect of the growth of the plant as a result of growth in the demand of man's requirements. These requirements are not merely mass requirements. Advertisement in the form of aesthetic suggestion and new productive uses has stimulated the sectional requirement of grades amongst manufacturers; this, together with the spread of education and changing political values amongst the growers of the raw material calls for specialized administration and management. It means that there can be no useful purpose served by harbouring the idea that there is any distinction between agriculture, the plant, commerce and manufacture. Modern tropical agriculture is entirely a response to the industrial stimulus of the nineteenth century, and the prosperity of tropical agriculture ebbs and flows according to the wants and requirements of northern countries and the competition of warmer countries producing similar tropical produce under different circumstances. Concerning cotton an exceptionally arresting instance of industrial development and decline is to be seen in the West Indies as the result of the present absence of demand for Sea Island Cotton. The development of that little industry was brought about by enterprise, science and organisation; its troubles were investigated and largely remedied, and a bio-ecoromic machinery evolved which in respect of a tropical industry has not been equalled in any other part of the world. Now after all the pains expended there is a possibility that it will be necessary to substitute something in its place after it has actually functioned as the economic salvation of at least four islands. It would seem to be evident that something more than the old type of farmer's outlook is needed in agriculture to-day, something more than a knowledge of technique and so-called practical work or even ordinary science. In tropical agriculture we are at work with vast forces of growth, competition and changes, and the present showing seems to be that the only way to meet them is by means of mass production namely, the growth of produce on the largest scale and on the most industrialized and scientific basis—until circumstances alter to change our point of view and show the necessity for adopting some other and equally radical policy of procedure.

PLANTATION PALM OIL.

Palm oil and kernels, the product of the West African oil palm (*Elaeis guineensis* vars.) form the basis not only of the largest and most important of the West African plant industries but also form the basis of soap and other manufacturing industries and commerce in the United Kingdom and elsewhere. In 1922, for instance, the United Kingdom imported palm oil and kernels from Nigeria—the principal producing country—valued at over £4,500,000 and in addition £690,000 worth from Sierra Leone. Being a forest industry and the product being collected and largely prepared by the natives individually with little cost except in energy, the production of palm oil possesses economic characteristics which are in many ways unique. To some extent, as in the case of rubber in Brazil and chicle in Central America the system means each year going further afield for fresh supplies (though in other ways the American industries are entirely different); but what the system does mean most is a great expenditure of unnecessary human energy, inefficient methods and a possibility that should other systems of production become established elsewhere palm products of better quality might be produced at a lower cost both per acre and per ton with a consequent fall in price or price discrimination, to the detriment and perhaps ruin of the West African industry.

Such a contingency is within the realms of practical possibility owing to the development of commercial palm oil plantations and central factories in Sumatra, and experimental plantations in several other tropical countries. This has been realised in England, in Nigeria and in other parts of West Africa. The Nigerian export tax on palm products has been reduced by 40 per cent. In England, milling engineers have concentrated on producing special machinery for extraction and apparently with success. For some time the Department of Agriculture in Nigeria has been endeavouring to improve and control native methods of preparation. It is only comparatively recently however that conclusions have been arrived at in regard to industrial and economic re-organization in anticipation of the menace of Sumatra and apparently this has also been prompted by the additional motive of helping the individual native. Mr. O. T. Faulkner, the Director of Agriculture in Nigeria, considers that although the development of plantations is not yet necessary in Nigeria, the extraction of the oil by machinery is, and that the most economical method is by means of central factories. The great difficulty lies in choosing suitable sites. But by far the most interesting feature of the Nigerian investigations has been the determination of the number of man-hours utilized in preparing the "hard" and "soft" oils. Since each native is his own labourer this is the only means of determining the cost of production, and the results are exceedingly interesting. "Soft" oil is prepared from fresh unfermented fruit and is much more laborious

than preparing "hard" oil. To prepare a ton of "soft" oil takes 420 man-days, whereas to make an equal quantity of "hard" oil takes only 132 man-days. A premium of £1 per ton in favour of "soft" oil gives only 0·83*d*. per day for the extra labour involved. At present (February) the premium of "soft" over "hard" is in this neighbourhood. It would certainly appear that the premium should be nearly ten times £1 in order to give the native a reasonable reward for his extra work. Even in the preparation of "hard" oil it does not appear that the native secures very much in the way of a remuneration after deductions on the price in Liverpool have been made at the trading stations in Nigeria. At the present time the prices of all vegetable oil products—including copra—are exceedingly firm; and if this firmness is likely to be maintained there is little doubt that big expansions of plantation palm oil will take place in Sumatra.

In view of all this (including the fact that even coconut products may be affected), it will be interesting to consider the origin of plantations in Sumatra, the methods employed and the nature of the results which have so far been obtained there.

The establishment of oil palm plantations in Sumatra was commenced in 1911 by a Belgian firm (the Hallet undertaking), and within four years 6,500 acres had been planted. The plantations had been made at various localities on the east coast of the island, including Poeloe Radja in the southern part (Upper Asahan), Deli Moeda in the centre, and Soengei Lipoet in the north (South Achin). Extension was delayed owing to the European war, and at the beginning of 1917 the area devoted to the oil palm was still only 6,500 acres. Since that time, however, the industry has developed rapidly and oil palms are now to be found on the east coast on nearly every type of soil and at altitudes ranging from 30 to 1,500 feet. By January 1, 1918, the area had increased to 8,500 acres, two years later to 17,100 acres, and by January 1, 1922, no less than 28,067 acres had been planted.

According to the "Bulletin of the Imperial Institute," from which this information has been taken, the oil palms in the plantations in the Dutch East Indies are derived from the seed of four trees grown in the Botanical Gardens at Buitenzorg, Java, two of which were sent from Mauritius in 1848, and the other two from the Hortus Botanicus at Amsterdam in the same year. All the oil palms in the Dutch East Indies are, however, of a uniform type in spite of their having originated from plants from two different sources. The probable explanation of this fact is that the plants received at Buitenzorg, from Amsterdam belonged to the same lot as those received from Mauritius, and that plants were sent from Mauritius to both Amsterdam and Buitenzorg at the same time. Moreover, the common type of oil palm in Sumatra, spoken of as the "Deli" type, is identical with that of the trees growing in the Economic Gardens at Buitenzorg which were raised from seed from the Botanical Gardens. There is little doubt, therefore, that the palms growing at Buitenzorg and those in Sumatra had a common origin. The statement that the seed planted on the St. Cyr estate in 1884 was derived from Singapore is now considered to be probably inaccurate and reasons are adduced for regarding it as more likely that the St. Cyr trees are also the offspring of the Buitenzorg trees.

The Deli type is a good form of *Elaeis guineensis*, Jacq., var. *dura*, and is quite satisfactory as regards yields and the purity of the seed. The amount of shell, however, is rather high, and forms 30 per cent. of the weight of the fruit.

Concerning the varieties in the oil palm, a fairly complete collection of the varieties of *Elaeis guineensis* has been secured for selection work at the General Experiment Station of the A.V.R.O.S. and a preliminary classification has been made which is based on the thickness of the shell of the nut and is nearly identical with the classification of E. Annet in "Le Palmier à Huile au Cameroun et en Afrique Tropicale" (Paris 1921). Four main varieties are distinguished; var. *macrocarya*, var *dura*, var. *tenera*, var. *pisifera*.

In addition there is the "diwakkawakka" form in which the pericarp is surrounded by a mantle (containing oil) which is said to be composed of six accessory sterile carpels. This type has been, described by Annet as *Elaeis Poissoni*. The fruit consists of mantle pulp, 50 per cent.; pericarp pulp, 34·5 per cent.; shell, 11 per cent.; and kernel, 4·5 per cent.

As regards selection work, trials with four lots of Lisombe seed imported from Africa resulted in each case in the production of a mixture of good and bad forms. The thick-shelled *macrocarya* was invariably present and, in two cases, nearly the whole of the offspring was of this form. The ordinary *dura* type was also present in every case, but in varying proportions. The thin-shelled *tenera* was represented by large numbers in two of the lots, but was nearly absent in the other two. The shell-less or *pisifera* type occurred in one case only.

Similar results have been obtained at Buitenzorg, imported seed always giving a mixture of different forms; in several cases there was a preponderance of the inferior types.

It is therefore inadvisable to plant large areas with imported seed, and the Deli type must remain the standard form for the east coast of Sumatra until a better form has been established by selection work with the offspring of newly imported varieties.

The General Experiment Station of the A. V. R. O. S. is working in two directions to improve the oil palms of Sumatra. In the first place, an endeavour is being made to remove all the thick-shelled (macrocarya) forms from the trees grown in the seed gardens from imported seed. Every tree with thick-shelled nuts is rigorously removed in order to prevent the dissemination of this type. The planters in Sumatra are co-operating with the Experiment

Station in this work, as they are fully cognizant of the risk of deterioration of the Deli type by the presence of these undesirable forms. Secondly an effort is being made to develop a variety with a low percentage of shell, a high total yield, and breeding true to type. A number of trees have already been selected of the thin-shelled (tenera) type, which bear fairly large fruits with a low percentage of shell and a large kernel. The bad types will be removed from the offspring of these trees so that fertilisation will only be possible between the good types. Attempts are also being made to obtain seeds by artificial self-pollination, in order to hasten the production of a pure strain of the desired type.

The Experiment Station has imported seed of nearly every type mentioned in the literature, and the best types of the Lisombe (tenera), the shell-less (pisifera), and the " diwakkawakka " form are to be used as a basis for future selection work.

With regard to the planting of oil palms, in selecting seed for sowing, the planter should choose trees (of the Deli type) which yield as large a total amount of pericarp as possible—*i.e.*, trees which produce numerous fruits with a large percentage of pericarp—and from these select only such as bear the best type of fruit.

The chance of obtaining good offspring can be increased by artificial pollination.

Volunteer plants should not be used as they usually develop unsatisfactorily.

In selecting seed for sowing, good ripe fruit should be chosen. Fruit which does not fall from the bunch, but is easily freed from it, germinates more rapidly than somewhat over-ripe or unripe fruit. Experiments have indicated that fruits which have been picked by hand from the bunches have the best germinating power. The seed of such fruits germinates most quickly when sown as soon as possible after the fruit has been gathered. Seed imported from Africa germinates very slowly, and seed from Java germinates more slowly than fresh seed produced in Sumatra. Imported seed is generally received in the form of nuts, and these germinate best when they have been so packed as to prevent excessive drying. The most satisfactory method is to pack the nuts in a moist mixture of charcoal and sand, but almost as good results are obtainable from nuts which have been coated with paraffin wax and packed in paper or wood shavings.

The nuts germinate more quickly than the whole fruits, but generally, under ordinary conditions, only about 50 per cent. germinate within nine months. As this slow germination hinders the development of a plantation, experiments have been made to devise means of hastening it. Several methods of effecting more rapid germination have been discovered, such as fermentation, treatment with warm water, with water saturated with chloroform, or with water containing alkali or acid. In general, heating the seed has been found the most satisfactory method. Seed kept for two weeks in pits in which the temperature rose to nearly 40° C. gave a germination of 60 to 80 per cent. within three to four months. By placing the seed after heating, in cold water, which was changed every day, a germination of 86 per cent. was obtained in three months after planting. Another method, which gave rather better results, was to place the seed, after heating in water which was heated every morning to 40-45° C. and then allowed to cool. Good results have also been secured by placing the nuts in a shallow pit between layers of stable manure or a mixture of oil palm fruit pulp and stable manure. Whole fruits, which had been wrapped in a wet sack and placed for five days in a zinc-lined chest at 40-50°, gave a germination of 77 per cent. within 100 days.

Annet has recommended planters in the Cameroons to ferment the fresh fruit for eight days in some receptacle before sowing. During the fermentation the temperature rises to 60-70° C. It is considered in Sumatra, however, that this temperature is too high and that the most reliable results are obtained by not heating above 40° C.

Concerning the methods of raising the plants and transplanting them, as the result of numerous observations, it is concluded that a spacing in the plantation of about 9 by 9 metres (or 30 by 30 feet) is sufficient for oil palms growing under good conditions. In a quadrangular system of planting there would then be 123 trees per hectare (49 per acre) or in a triangular system 143 trees per hectare (57 per acre).

As regards the upkeep of an oil palm plantation it appears that in regard to inter-planting, Robusta coffee has been planted on a large scale between the oil palms on the east coast of Sumatra, and that there appears to be no objection to this practice in situations possessing conditions similar to those of a rubber plantation in which coffee could advisedly be grown between Hevea trees.

The planting of cover crops is recommended in preference to clean weeding. For this purpose *Mimosa invisa* and *Centrosema Plumeri* are recommended among creeping plants and *Tephrosia candida* and *Crotalaria usaramoensis* among erect plants.

Measures to be taken to prevent soil washing are described, and it is pointed out that these will vary according to the contour of the land and the character of the soil.

With reference to the question of manuring an oil palm plantation, it is estimated that in the formation of the leaves and bunches of fruits the quantities of food constituents extracted from the soil per hectare per annum amount to 131 kilos. of nitrogen, 204-250 kilos. of potassium and 40-65 kilos. of phosphorus, corresponding respectively to 117, 182-223, and 36-58 lb. per acre. Until recently in the clean-weeding system which was adopted, the leaves and the remains of the bunches and pulp were not returned to the soil, and hence the greater part of the large quantities of plant food extracted from the soil did not become available again for the palms. It is therefore of great advantage that green manures are now being increasingly planted,

as this will probably entirely compensate for the nitrogen taken from the soil. In order to supplement the supply of other constituents, the ashes of leaves, pulp residues and fruit stalks should be returned to the soil, together with other plant ashes, if available. Special experiments are needed to ascertain whether artificial manures could profitably be applied.

An account is given of pruning experiments started in 1919 on the plantations of Mata Pao and Poeloe Radja. Rutgers says that pruning should be restricted to the leaves which it is necessary to remove for harvesting the bunches. The results of the experiments confirm this view and show that the minimum of pruning gives the best results. It is not necessary to trouble about the pressure of the leaves on the swelling bunches, and this is especially the case when artificial pollination has been practised. It has been found that the total fruit production of heavily pruned trees decreases much more rapidly than that of normally pruned trees.

The artificial pollination of the oil palm is of great interest. In order to study the economic effect of artificial pollination, an experiment was commenced on the Mata Pao estate in October 1920. Of two plots, each of 7 hectares (17½ acres), the trees on one were artificially pollinated at intervals of three days, while those on the other were left to natural pollination. The result showed that in the first two harvests the total crops of fruit from the two plots were 8,817 and 3,416 kilos. respectively, the artificial pollination thus giving an increase of 158 per cent. The experiment is being continued in order to obtain trustworthy figures.

The pollen should be collected at 3 p.m., as at this time of day the atmosphere is dry. It is best stored in glass-stoppered jars containing quicklime. A convenient apparatus for pollinating the flowers is described, which consists of a form of spraying flask or atomiser. It is estimated that from 500 to 1,000 trees in which the inflorescences can be reached without a ladder, can be pollinated by one worker in a day of eight hours, but where a ladder has to be used a longer time is necessarily required.

There is a method described for estimating the age of an oil palm by counting the leaves and leaf-bases. The number of leaves produced per annum by the oil palms on the east coast of Sumatra is from 20 to 24, but after the fifteenth year the number slowly decreases.

With regard to the diseases and pests of the oil palm the following are the chief ones which have been observed in the Dutch East Indies.

The crown disease, the cause of which is unknown, is the most important disease in Sumatra. It generally attacks young palms, especially those between one and four years old. In some cases it only affects the leaves of the central spike, but in other cases the youngest leaves surrounding the spike are also involved. The trees invariably recover, and no trace of the disease is visible in later years.

Among beetles, *Oryctes rhinoceros*, *O. tuberculatus* and *Rhyncophorus ferrugineus* have been observed, but have not hitherto caused any great damage.

The caterpillar of a Pyralid moth, *Melissoblaptes rufovenalis*, has been found damaging the epidermis of the fruits but without causing any injury to the crop. *Orthocraspeda trima* and *Setora nitens*, caterpillars of the family *Limacodidae*, have been noticed feeding on the leaves of the oil palm, but neither has become a serious pest. The caterpillar of a Psychid moth (*Lansdownia bifenestralis*), has so far proved the most harmful insect attacking the oil palm in Sumatra; in some cases several hundred trees have been defoliated by it.

Boring beetles (Scolytidae) have been observed boring the midrib of the oil palm leaf, but apparently without producing any appreciable injury.

Rats, pigs and porcupines sometimes damage the young palms and have occasionally caused the loss of large numbers of the trees.

The various methods for the preparation of palm oil are of great interest. In order to obtain a product containing a low percentage of free fatty acids, it is in Sumatra regarded as necessary to avoid (*a*) the use of bunches with loose ripe fruits; (*b*) the use of ripe fruits which have fallen to the ground; (*c*) bruising the fruits when cutting off the bunches; (*d*) bruising during transportation; (*e*) removing the pericarp from the fruits before they have been thoroughly heated; (*f*) treating the fruits without preliminary sorting; (*g*) any cause which prevents the fruits being worked up immediately or necessitates the storage of the fruits and bunches in heaps; and (*h*) the burning or browning of the oil by heating the fruits over an open fire.

For the preparation of palm oil, the method employed at first by the European undertakings in Africa was the wet process, as exemplified by Haake's method, but this has now been abandoned in favour of the dry process.

In preparing palm oil by the latter process, the three main steps are heating, depulping or depericarping and pressing. Various methods of heating the fruits are mentioned, and it is stated that experiments have indicated that the best plan is to heat the whole bunches, as this has the advantage that, after heating, the fruits can be easily removed and the question of bruising is of less importance. Two pressings are necessary, the first under low pressure and the second under high pressure. After the first pressing the fruits are depulped and the pulp is dried. The dry material can then be subjected to high pressure without expressing any of the cell contents with the oil.

In connection with threshing machines for oil palm fruits, experiments are recorded which were carried out with the object of testing a machine, constructed by the firm of Reinartz, of Neuss, for stripping the fruits from the bunches. It has

been found that good results can be obtained with this machine if the bunches are previously heated.

The method presents the following advantages: (*a*) It diminishes the cost of preparation below that of other methods used in the production of edible palm oil; (*b*) manual labour is reduced to a minimum; (*c*) sorting can be dispensed with; (*d*) the bunches can be worked immediately, so that storing in sheds is unnecessary; (*e*) the fruits are brought in from the plantation while still on the bunches, and crushing and bruising are thus more easily prevented; (*f*) the formation of free fatty acids after the bunches arrive at the factory is avoided; and (*g*) the oil obtained is of an edible character. On the other hand, the method has the disadvantages that (*a*) the weight to be transported is twice as great in the case of the bunches as in that of the fruit, and (*b*) plant is necessary for heating the bunches.

Concerning the packing, shipping and selling of palm oil, the "Bulletin of the Imperial Institute" refers to information given regarding the markets for palm oil and the methods for packing it for shipment, and to extracts from the "Official Contracts for Palm Oil" issued by the Liverpool United General Produce Association, regarding the classification of palm oils and the allowances to be made by sellers for impurities and excess of free fatty acids. These contracts are evidently not intended for the marketing of palm oil with a very low percentage of free fatty acids (say under 8 per cent.) to be used for edible purposes, as the official contract in general use in Liverpool in January, 1922, allows only an increase of 0·1 per cent. of the price (or 1*s.* 9*d.* per ton) for each 1 per cent. of free fatty acids under 18 per cent. It is considered necessary therefore that a new class should be made for edible palm oil, with a special premium for each 1 per cent. reduction in the free fatty acids, and it is stated that manufacturers of edible fats are willing to pay a much higher price for palm oil with a very low percentage of free fatty acids than for ordinary palm oil, provided that sufficient quantities of uniform quality can be regularly supplied.

Of much importance is the suggestion of a standard palm oil cask. The casks employed in the African trade are usually returned to Africa and used again and again. As the Sumatra palm oil is more liquid than the African, the rate of leakage from casks that have been used several times is greater in the former case. It is suggested that in the future it may perhaps be possible to ship the Sumatra product in tank steamers, but meanwhile the standard casks must continue to be employed. Some authors have advocated the hardening of the oil before shipment, but this would involve a considerable increase in the cost of preparation. Better results might possibly be obtained by bleaching the oil, which converts it into a homogeneous white solid fat without any liquid fractions.

Bleached palm oil has already been shipped by one of the Belgian undertakings in Sumatra, and the difficulties due to leakage have thereby been much reduced. It seems not unlikely that in the future bleaching will be generally practised on the oil palm estates. The Experiment Station proposes to investigate the comparative value of the bleaching apparatus for palm oil now offered by machinery manufacturers.

With regard to crop records of oil palms, in previous publications of the A.V.R.O.S., the yields have been recorded of several series of oil palms on the east coast of Sumatra. Additional data are now quoted relating solely to trees of the ordinary Deli type, which are divided into two groups: (1) plantation trees, and (2) ornamental trees, planted along roads and avenues. The latter, as a rule, had been grown under bad conditions; in some cases they were only 12 to 15 feet apart; in other cases they had been planted too near to Teak or Ficus trees; whilst in many cases they had been entirely neglected in past years.

The observations were made on the same lines as in the earlier work, and statistics are given of (1) the gross yield of bunches and of fruits per tree per annum, (2) the percentage of pulp, nuts and kernels in the fruits, and (3) the percentage of oil in the pulp and kernels.

In the fourth year a tree yields about 40 lb. of fruits; this rises steadily to 99 lb. in the eighth year, when there is a sudden jump to about 210 lb. After 25 years a declining yield sets in, but even at 40 years the tree gives 60 lb.

The high yields of the trees of the age of 10 to 15 years were obtained in the first year after the trees had been cleaned, and during six months of that year artificial pollination was practised. These yields therefore cannot be regarded as normal, and in future years the crops from these trees will probably be smaller.

The crop of fruits in Sumatra is not evenly distributed over the different months of the year but shows a distinct periodicity, which is induced by the periodicity of the rainfall. The maximum crop is obtained in the dry season and the minimum in the wet season. The months in which the largest number of bunches ripen are also those in which the weight per bunch is greatest. It appears that a high annual rainfall evenly distributed through the year gives the best results. The maximum production per month is nearly twice as great as the average monthly production, and it therefore follows that the factory equipment must be sufficient to work at least double the average daily output of the estate.

Data collected during 1918 and 1919 regarding the percentage of pulp, nuts and kernels in the fruits confirm the previous conclusion that the palm fruits produced on the east coast of Sumatra contain on the average, 60 per cent. of pulp and 8 per cent. of kernels. The percentages are practically the same for young and old trees.

Determinations of the percentage of oil in the pulp and in the kernels have shown that although the amount varies in fruits from individual trees of the same variety, and even in fruits from the same tree, the average quantity may be safely taken as 50 per cent. in the pulp and 50 per cent. in the kernels.

It is calculated that a young oil palm plantation on the east coast of Sumatra will yield 1,350 kilos, of palm oil and 450 kilos. of kernels per hectare in its fifth year (1,200 and 400 lb. respectively per acre), and that the yield will increase to 2,000 kilos. of palm oil and 600 kilos. of kernels when the trees are in full bearing, *i.e.* from the tenth to the thirtieth year (1,750 and 535 lb. per acre).

Assuming a price of £40 per ton for palm oil (which is ruling at present—February) and £25 per ton for kernels, the return per hectare in the fifth year will be £54 for palm oil and £11 for kernels, whilst when the plantation is in full bearing the annual return will be £80 for palm oil and £16 for kernels, or a total of £96 per hectare (£39 per acre). This is a very high gross return compared with £22 10s. per acre for good yielding coconut trees, with coconuts at £4 10s. per thousand or in the case of copra £35 per acre with copra at £30 per ton.

JAMAICA CONFERENCE.

The ninth West Indian Agricultural Conference began on January 28, last, at Kingston, Jamaica, under the Presidency of Sir Francis Watts, K.C.M.G., and was brought to a successful conclusion on February 1. As announced in the last issue of this Journal, the proceedings were opened by His Excellency the Governor (Sir Leslie Probyn, K.C.M.G.), whose speech was followed by the Presidential Address giving an outline of the course of agricultural affairs in the West Indies since the last conference was held in Trinidad in 1912.

In regard to the Imperial aspects of tropical agriculture, Dr. A. W. Hill, F.R.S., called attention to the value to tropical planters and investigators of the extensive collections and records not only of plants but of plant products at the Royal Botanic Gardens, Kew. Dr. S. A. Neave, representing the Imperial Bureau of Entomology, spoke on the need and value of research in pure science and the various functions of entomological research in regard to tropical agriculture. Mr. S. P. Wiltshire reviewed recent developments of the Imperial Bureau of Mycology. In regard to the Banana industry which has reached such large dimensions in Jamaica, the Hon. H. Cousins, M.A., Director of Agriculture, pointed out the general upward tendency of prices in the past, and emphasized the fact that in Jamaica bananas were a stabilised and profitable crop largely in the hands of the small growers. In connection with botanical aspects, Professor S. F. Ashby showed that Panama disease is not identical with diseases having similar symptoms in Java. A paper by Professor J. S. Dash gave a resumé of the fertilization work with bananas in Trinidad inaugurated originally by Dr. T. G. Mason. Professor Harland put forward his views in regard to new types of bananas, while certain aspects of the industry in relation to Trinidad and other places were dealt with by Mr. W. Nowell.

Much interest was aroused in regard to cacao by a paper read by Professor Harland on the subject of his researches in connection with budding and pollination, it being shown that in budded cacao the stock is capable of influencing the yield of the scion. General experimental and commercial aspects of cacao in Trinidad were given attention by Mr. W. Nowell and Mr. W. S. E. Barnardo.

Concerning cotton, an account of cotton stainer control in St. Vincent by means of close seasons, field sanitation and destruction of wild-food plants together with similar aspects in regard to pink boll worm control, was given by Professor H. A. Ballou, followed by notes on breeding policy by Professor Harland in which attention was called to the possible value of establishing the Janovitch type in place of West Indian Sea Island Cotton.

Researches in connection with the sugar industry described by Mr. R. G. W. Farnell, Research Chemist to the Empire Producers' Sugar Association, had particular reference to the importance of colloids in manufacture. Coconuts were considered mainly from the disease aspect, and a paper by Professor Ashby emphasized the likelihood that seed nuts are responsible to a large extent for the dissemination of red ring disease.

A notable and instructive feature of the Conference was the Hon. H. H. Cousins, demonstrations in regard to the live stock industry. It was made evident that highly important results had been achieved at Hope Farm in the matter of producing cross breed and grade cattle for producing excellent quality milk under tropical conditions. Tick control had also been successful in Jamaica. An interesting paper was read by Mr. Barnardo on goats.

Concerning education a paper on the Jamaican educational problem by the Hon. A. E. Harrison attracted special attention while the observations and speeches by Sir Arthur Shipley, Sir Francis Watts and others in connection with the more general aspects of the subject in relation to development and progress were listened to with great interest.

The joint secretaries of the Conference, who also participated in the discussions, were Mr. C. C. Gowdey, Government Entomologist, and Mr. C. G. Hansford, M.A., Government Mycologist, Jamaica. The papers read at the Conference are being published in Jamaica *verbatim*, and will shortly be available for readers interested in the subjects dealt with.

THE TROPICAL WORLD.

DUTCH EAST INDIES.

The decision recently arrived at by the Government to allow a certain proportion of the capital cost of mature rubber areas to be written off each year by way of depreciation—the amount being charged as a working expense for taxation purposes—is a matter of fundamental importance in respect of cost accountancy, and one which the Economics Department of the Imperial College of Tropical Agriculture has been urging for some time, upon all planters of permanent crops, for consideration. As the editor of the rubber section of "Truth" observes, it raises the question as to what the length of life of a rubber tree is. In the East apparently, the average commercial life is placed at twenty years, though it is recognized that after fifteen years the tree is regarded as on the decline. Quite possibly the life of a rubber tree may extend to eighty or even a hundred years; this however does not lessen the importance and fairness of taking depreciation into account. The book depreciation of an article is its original capital cost divided by its length of effective life. The Dutch Government apparently is not likely to allow annual depreciation of more than 2 per cent. of the original capital cost.

CEYLON.

At a meeting of the Board of Agriculture a few months ago the question of further provision for agricultural education was brought up especially in regard to the elementary schools. Of the 3,000 boys who pass out of these schools each year only 500 take up agricultural work, the remainder drifting to the towns there in many cases to eke out a miserable existence. Increase in the number of native proprietors is urgently needed in Ceylon in regard to the food supply question and it seems to be the opinion that this can be remedied by school gardens and agricultural teaching in the schools. This is very doubtful judging by past experience not only in the West Indies but in Ceylon itself where at least 500 of the schools already have gardens, and where a form of higher agricultural education is provided for at Peradenyia. The general result of experience seems to be that successful land settlement requires thorough organization and supervision and the certainty of the sale of produce at a price sufficient to give an attractive profit. That the authorities are alive to the economic aspect of things is shown by a recent investigation of the Ceylon Government Statistical Department into the labourers' wages and the cost of living on estates. The report deals at great length and in detail with the conditions of living among estate coolies, the advantages they enjoy in addition to their pay, their expenditure on commodities. It is estimated that the typical monthly budget of a single coolie is 4·88 rupees, and of a family with two children under fourteen, 13·33 rupees. The average amount earned per head was 5·31 rupees for April last and 6·06 rupees for May.

NYASALAND.

Certain parts of South and East Africa, of which Nyasaland is one, are of particular interest as the modern home of European settlement within the tropics and a little southwards. Orange growing in South Africa has featured prominently in the advertisement columns of the London papers for several years and small investments of say £1,500 are stated to yield within a few years net incomes of £1,000. According to a planter of Nyasaland who contributes an anonymous article to a recent issue of "The Field," tobacco planting offers possibilities for further enterprise in the Shire Highlands of that country; but the writer is sincere enough to sound a word of caution as to possible pit-falls. Still it would seem that on Crown lands a fairly safe venture could be undertaken with a capital of £2,000 and if the demand for light tobacco changes as it seems to be doing to heavy dark the problem of wood-fuel supply for curing is less of a problem since in the case of heavy dark tobacco most of the treatment is effected by air and open fires. Nyasaland is a country which has made much progress and offers distinct possibilities for investment; but just for the present things are a little problematical. If the railway to the southern end of Lake Nyasa is built and cheap freights are offered there will undoubtedly be a future and attractive openings for the ordinary capitalist planter.

UGANDA

Mr. S. Simpson, the Director of Agriculture, in a report on the position in regard to cotton at November 10, last, states that very little cotton remained to be exported from the last season's crop and that transport arrangements proved to be both adequate and satisfactory. The general revenue of the Protectorate for 1923 had already been credited with £100,831 from the excise duty on cotton, and this money, as Mr. Simpson states, is bound to have an important effect on the permanent development of the country. The acreage under cotton for the present season shews a 20 per cent. increase in the Buganda Province. The Northern and Western Provinces have also planted up more cotton but the crop at present in these areas is small. In the Eastern Province the area under cotton amounted to 298,070 acres and good yields were anticipated. Concerning labour conditions in the Protectorate because it is the duty of Government to provide as far as possible against unemployment and protect in East Africa, native interests, the recent Bill to consolidate and regulate immigration and employment in the Protectorate is seemingly both consistent and important. According to this Bill, any immigrant likely to become a pauper or public charge is to be prohibited from entering the country. A Government Immigration and Employment Department is to be established, while at Nairobi, the capital, an Immigration and Employment Board is to be set up to instruct the Immigration and Employment Officer with regard to economic

requirements. The Bill is based upon general principles agreed upon between the Governments of Kenya and Uganda respectively.

INDIA.

The work done by the Indian Sugar Bureau for the improvement of the sugar industry of that country has now been fully recognised by the Government and has the full support of the United Indian Sugar Producers' Association. This is not to be wondered at considering the important work which has been done not only in connection with the breeding and acclimatization of new varieties of sugar-cane, but also in connection with the manufacturing and the commercial ends of the sugar industry. In regard to seedlings the demand of growers has in recent years been so heavy as to necessitate planting very large acreages at the Experiment Station, and one reason for this demand lies in the fact that the Coimbatore canes yield over double the amount per acre than do the native varieties. As regards manufacture, the principal industrial enterprise has been shown in Bihar and the United Provinces where prospects for development are very favourable. Messrs. Begg Sutherland and Company manage seven sugar factories in these provinces and a new factory has recently been erected at Pachrukhi near Sivan. It will be remembered that Mr. Noel Deerr's services were recruited by the Company mentioned above, indicating the importance attached to scientific control. The Bureau, it is interesting to note, has assisted these factories in respect of bringing forward the names of persons suitable for employment. As regards commercial activities the most striking feature of the Bureau's activities has been the initiation of a cable service affording daily news throughout the country as to sugar prices. This has proved of the greatest value in stabilizing the sugar markets in India by preventing any panic or sudden rise, which has so often taken place, due to unofficial reports and even deliberately false rumours alleged to emanate from foreign countries.

SOUTH AFRICA.

While reference to agricultural conditions in the Union of South Africa may be appropriately made on this page, it must, however, be preceded by the apparently paradoxical statement that the Union is not a tropical country. But as in the Southern United States, so in South Africa, conditions in places and at times approach closely to those of the tropics and crops and stock common to both tropics and warm temperate regions can be and are grown there. In any case the energy, organization and outlook of the Department of Agriculture of the Union (which costs £964,000 per annum) are things to be studied by all tropical countries, and attention is therefore drawn specially to the report of the Acting Secretary of Agriculture, Mr. G. N. Williams, D.S.O., with its foreword by the Right Hon. Sir Thomas Smartt, K.C.M.G., Minister of Agriculture, having reference to the recent state of affairs agricultural. According to this, great and widespread interest is being shown in the Union in regard to cotton production, and there is every sign of a rapid extension taking place. The dried fruit industry which is now of great dimensions is thriving steadily; but the prime producer of the country's wealth is wool. The cattle industry waned somewhat during 1922-23 owing to swamping of the market with cheap imported meat and not by disease which, especially East coast fever, is being kept under control. Ostrich production, also an important animal industry, declined as well. Tobacco producers have had difficulties to contend with, and while the maize crop has been exceedingly large, the heavy exports of this grain has caused some anxiety as to local supply. Much attention and a great deal of money is spent on agricultural education in the Union, including that on Colleges and extension work, but the line of action to which the Department attaches most importance is organization amongst the farmers and the sending of permanent commercial representatives to the overseas markets which take South African produce, with the object of protecting and furthering South African interests.

MADAGASCAR.

Agriculturally this country, which is the third largest island in the world, is mainly interesting for its production of coconuts and vanilla, though considerable quantities of rice are also grown as well as a crude form of tobacco as a native industry. A development of recent years in respect of animal industry is the Usine de Soanierana, which appears to be a large and well-organized factory for the manufacture of corned beef, tongue, beef juice, sausages, lard and ham. A new plant which was finished at the end of 1923 will enable the operations to proceed without interruption right through the year. The average number of cattle used per day is 80, and in the case of pigs 40. Four hundred and fifty natives are employed at this concern together with a staff of six Europeans. In regard to health conditions, with the intention of reducing mosquitoes in streams, Dr. Legendre, a local scientist, introduced in 1914 the fish known as the carp, which will also serve it is hoped to increase the local food supply. Although of agricultural importance and of extraordinary great biological interest, Madagascar is still to-day most prominent economically in respect of its minerals. Great and easily worked deposits of graphite occur and there are indications of deposits of petroleum and of bitumen. The country, which has an area of 228,000 square miles and a population estimated at 2,700,000 was taken by a French expedition in 1895 and was declared a Protectorate. In 1896 the country was proclaimed a French colony. The name of the capital is Antananarivo at which there is a British Consulate from which information concerning progress and development is always obtainable.

THE TRAINING OF MANAGERS.

PROFESSOR W. R. DUNLOP.

It was stated in the last issue of this journal that in view of the urgent need of greater recognition of the importance of the management aspect in tropical agricultural education, further attention would be given to the question of training from different points of view.

In considering this important and highly controversial question it is necessary to be clear as to what one is thinking of under the term of manager. Sir Daniel Hall, whose views on agricultural education were published in the last issue of the journal, is referring to the ordinary British tenant farmer or farm-owner operator. A student of tropical agriculture who has means and definite prospects of commanding capital and really wants to plant, or the student who is the son of a planter and will inherit an estate and wishes to make it his life-work and interest, is likely to benefit both financially and otherwise from a training in management based principally on cost accountancy, agriculture, agricultural botany, chemical technology and the like—by the courses, in fact, laid down in the new Syllabus of the Imperial College of Tropical Agriculture. Both types however will need experience before being capable of undertaking full managerial responsibility, though, with a proper training and proper College equipment, the time required for this experience need not be so long as most people imagine.

The small owner-manager, namely the so-called peasant proprietor, of whom there exist vast legions in tropical agriculture, is also likely to benefit by a certain amount of agricultural *instruction*. This however is work for local Departments of Agriculture and Education in different tropical countries, and must be in the nature of extension work for those who are already proprietors and consist of school agricultural instruction in the case of the children. This instruction should be sociological and bio-economic in character and based on the same principles as those underlying the training of the larger owner-manager.

When we come to consider the requirements of the manager in the generally accepted sense of the term in tropical agriculture namely the salaried manager employed by estate companies such as sugar companies, rubber companies, &c., we find it more difficult to give a practical prescription. These managers rise to their position by experience, generally by local experience, and in most cases from an overseer's position on the same estate or same controlled group of estates.

Is it possible, supposing that it were demanded, to train a student to become a manager straight from College without this overseer apprenticeship? It is generally agreed that it is not possible. Is any advantage to be gained by training young men to go out as overseers with the ultimate objective that they will become managers eventually? The practical employer will argue that even the overseer has to learn his work on the estate, while on the other hand we are faced by the fact that few young men with real ability would study at a College for three or four years to work as an ordinary overseer with ordinary prospects, which it must be admitted are not very attractive.

The thing to bear in mind is that the average employer, while realising the value of education and technical training, wants, first and foremost in his staff, energy, thoroughness, reliability and some power of initiative. Knowledge, theory, and intellectual ability are secondary considerations. It is because of this fact that tropical estates have been able to do without agricultural colleges in the past. They have been content to go to Government specialists with their troubles such as those concerning pests and diseases, or to employ specialists of their own in the case of large estates. The work of an overseer and manager has been to manage, to carry out instructions faithfully and carry on generally the work of an estate as a business proposition. In some cases this has been done highly successfully, in others less successfully, but it has always been on the basis of practical experience and practically acquired knowledge. Energy, experience, proved by results, are the qualifications for which the best salaries have been paid.

Large estates are not going to employ a man in general management, if they can help it, unless this man possesses the proper personal qualifications and outlook; a trained agricultural student possessing these personal characteristics is not likely to give his services with the present inducements.

Is this agricultural training, therefore, worth while? It is for the employer to decide. Personally I think it is, provided the idea of energy, necessity of hard physical work and business-like thinking are not weakened by the training.

The position gives rise to something in the nature of a dilemma, for neither employer nor possible employé nor even the educationalist knows quite how to act for the best. It is possible that Companies might begin by sending men, whom they had already selected for their personal qualities, to the Imperial College of Tropical Agriculture for some training, even if only for a short training say one covering a single session (9 months). The employers might even have a voice in what they consider this training should consist of. It would be very interesting and important to have such views. Another way Companies might act is by sending senior overseers whom they have an eye on for promotion as managers to the College for a special training also. Admittedly there are two difficulties (*a*) the geographical difficulty and (*b*) the academic difficulty of arranging these courses satisfactorily. The geographical difficulty embraces not only the time and expense of coming to Trinidad, but also the opinion so frequently held by practical employers that a local training in Trinidad is of little use in other places. This latter objection is in my

opinion superficial and wrong. Everything depends on what the training is to be. But in spite of controversies and objections it should be possible and well worth the effort to make an experiment in the ways suggested which might lead to fuller recognition of the value of training and to a fuller academic form of education in the future. What we really need are experiments, not in chemistry or botany or agriculture, but in agricultural education.

I have purposely been confining my remarks to general estate management and not to specialised factory management as in the case of sugar factories. Even here business experience counts most in respect of general management, though engineering and chemical training should also be necessary qualifications, in such cases.

The fact of the matter is, viewing things from a vocational standpoint, that to obtain a good salary in any managerial position demands experience and personal qualities. This experience on most estates, is slow and hard-earned. The bonus idea on estates is an excellent one so far as it goes: the trouble is that it does not necessarily reward good management. In my opinion a bonus should not be given in respect of increased profits produced by high market prices or good seasons or both, but rather given as a reward for reduction in unit costs, &c., or paid out of reserve for special work and suggestions and good management in times of crisis and depression.

The recognition of the business side of tropical agriculture as a promising career for the young man of real ability is urgently needed, and the effect would be to produce far-reaching results to the general benefit of the tropics. In order to stimulate this idea it would seem desirable to do all that is possible to give scope to ambition on estates, that is ambition based upon real ability to do something better. Experience is essential in estate work, but observation, imagination and the critical point of view on the part of the staff are also valuable. Developed by scientific training of the right kind, the greater use of these faculties would probably lead to improvements in methods of organization and far greater independence in respect of the control of pests and diseases and factory technology. No scientific or agricultural specialist has the same scope for making observations as has the estate worker, and there is little reason to doubt that if care is taken not to unfit him by training that that training would increase the employé's interest in the estate and prove generally valuable both to himself and to his principals especially in times of crises re-organization and changes of policy.

With reference to the training itself, it will be appreciated that I regard what may be called the psychological aspect as highly important. It is essential to preserve balance and not to teach too much. Courses for young overseers and older men on their way to becoming managers should include the principles of cost accountancy, agricultural technique and botany, statistics and marketing, engineering, pathology and even certain generalities of economic history and geography so that the student may be able to realise what has happened and is happening beyond the estate. It would be essential to instil principles rather that detailed information and to do this by means of practical exercises, demonstrations and illustrations. The great danger to avoid is unfitting the man for doing what he is going to be primarily paid for—namely, translating orders and ideas into action and managing money, people, the soil, plants, live stock and machinery. Incidentally a fair standard of general education would be necessary for the student fully to benefit by the kind of training I have in view. But keenness would be the real essential and presumably would be present as a condition for the facilities provided.

There is a final aspect of this complicated subject which will bear referring to—the higher forms of management, namely, administration and direction. Under these I include the direction of estates by Companies and Syndicates, the direction of agricultural affairs of a country by Departments of Agriculture, and the supreme legislative direction in such countries by Government. A fuller appreciation in these quarters of the principles of economics, of statistical method, of cost accountancy, biology, psychology and anthropology and a closer and more accurate acquaintance with the history and geography of tropical industries throughout the world, would do much to create closer sympathy and understanding as regards educational requirements, and tend to lead to the formation of greatly improved agricultural and economic policies for the general welfare of tropical regions.

TROPICAL FORESTRY.

Tropical forests are chiefly comprised of what is technically known as "relative selection jungle forests." This means that there is a low proportion of economic species and that for the most part these are not gregarious and that the whole condition is one of wild disorder. The general policy of development therefore lies not as most people suppose in planting but in demarcation, silviculture and natural regeneration. In India, however, teak has been grown artificially. In writing on Indian forest management in the "Empire Forestry Journal" for December, Mr. C. G. Trevor, Conservator of Forests, United Provinces, states that the easiest method of regenerating teak is by clear felling, followed by artificial regeneration with field crops. The Indian cultivators undertake for a moderate payment per 100 plants to weed the young teak along with their crops. The teak seeds are dibbled at stakes 6 feet by 6 feet, and very young plants are used as fillers where necessary. The latest development is to broadcast miscellaneous species between the teak, so that the ground may be covered quicker and the cost of weeding

after the first year reduced. The extent of the work being done in Burma may be judged by the fact that for the year ending March 31, 1921, 84,723 acres of these plantations existed in this province. Burma and Bengal have almost perfected this work, and any forester who may think of experimenting along these lines should certainly obtain all the literature on the subject from the Forest Research Institute, Dehra Dun. As regards the natural regeneration of teak, this has been obtained from seed stored in the ground after clear felling and burning. It appears that the young teak will not stand shade or drip, and must have complete overhead light. Regeneration has also been got by elaborate and repeated clearings, but most authorities prefer the simpler and less costly system of regenerating with field crops.

The above system is of great interest and importance, but it always has to be remembered that the production of timber is but one stage in forestry operations. Haulage and transport and marketing are equally essential and the suggestions of Mr. J. R. Ainslie, Senior Conservator of Forests, Nigeria, regarding marketing, in the Journal previously referred to, are of much interest.

At the present moment possibly under 5 per cent. of tropical timbers are marketable. The difficulties, says Mr. Ainslie, in connection with the sale of the remaining 95 per cent. are :— (*a*) lack of knowledge of these timbers and the conservatism of the trade ; (*b*) the great variety of species being generally found scattered over each unit of area of tropical forest. This results in : (*a*) exploitation of scattered individual species, necessitating costly extraction owing to the extensive areas which have to be worked to obtain a sufficiently large supply to justify marketing ; (*b*) difficulty in silvicultural management, as the selection system being the easiest under the circumstances is often the only system that is employed, and this in mixed tropical forests invariably results in forest deterioration ; (*c*) impossibility of centralising operations either in utilisation or transport, and also difficulty in labour control, thus rendering economical working difficult ; (*d*) either a high cost of production of any individual species or a supply so small as to render it negligible from a marketing point of view.

One can understand that as a result of these disabilities the only tropical species which are marketable at present are luxury species (the intrinsic value of which makes their exploitation worth while, even by inefficient and primitive methods) and utility species which are either naturally gregarious or have been assembled together by artificial means.

As examples of the former can be instanced satinwood, ebonies and mahoganies, and of the latter, mangroves, certain dipterocarps and plantations of certain species used for special purposes.

It is, however, of importance that the great potential supplies of the more ordinary tropical timbers which now exist should become available early and at reasonable prices, and not at prices enhanced by the approaching softwood famine and augmented by wastage resulting from failures in marketing. But the suspicion of traders regarding new species is not without foundation. They cannot be expected to possess an intimate knowledge of timbers which perhaps have not been subjected to any adequate test, and they have also learned from experience that before a consumer can be induced to buy he must have confidence in the suitability of the new timber for his particular purpose and must have some assurance of permanency of supply.

RECENT CHEMICAL RESEARCH.

THE STREAM LINE FILTER.—Considerable interest has been aroused in chemical technological circles by the performances of a new stream line filter has been invented by Dr. Hele-Shaw, (Proc. Roy. Soc., 1923, A. 103, p. 556 ; *see* J. Soc. Chem. Ind., 1923, 42, No. 35, p. T 353.) The mode of its action of this apparatus depends on the fact that when components in a liquid containing finely divided matter in suspension, or even a fluid mixture of two liquids of different densities, are spread out to form a thin film, a separation of the components occurs. In practice, the films are produced by forcing the liquid into a series of tubular canals formed by the proper alignment of a large number of perforated sheets of roughened impervious paper, packed together in a metal frame. There is no escape for the liquid except through the interstices of the sheets ; the filtration is therefore edge filtration, rather than surface filtration. The effluent passes through a second series of smaller tubular canals to an outlet. Periodically the separated solid material is washed out of the larger tubes, or ejected by means of plunger rods. To obviate discontinuity of action, stream line filters may be used alternately in a battery.

Dr. Hele-Shaw recently exhibited a stream line filter consisting of 24 packs of paper, each 6 inches in length, and containing 1,400 sheets, capable of dealing with 1,200 gallons or 5½ tons of liquid per hour, with a consumption of power of 2-3 H.P.

Amongst the results obtained by the use of the stream line filter, the following examples may be quoted. Sugar solutions containing colouring matter yielded perfectly colourless filtrates ; milk gave an almost tasteless clear liquid ; mixtures of dirty oil and water (bilge water) came through clean ; emulsions of oil and water were readily resolved ; and peaty water deprived of its colour. With proper pressure adjustments, it is possible (with this filter) to effect fractional filtration of liquids containing different sized particles, and to concentrate colloidal solutions to any desired degree.

F. HARDY.

RESEARCH IN BIOLOGY.

UNSUSPECTED SOURCES OF DISEASE.—The dissemination of diseases by insects has now been well established as a fact; the carriage of malaria by mosquitoes, of sleeping sickness by tsetse flies and of plague by fleas being some of the more noteworthy examples. Many disease organisms are however not limited to one specific host, and an insect which feeds on the blood of several species of animal may convey the same disease organism to all. Of the animals selected some are probably less susceptible or immune to the pathological effects of the injected micro-organism and such hosts then act as reservoirs for the disease of a susceptible animal.

A disease of cattle in Africa, known as nagana, may be taken as an example. The blood parasite or trypanosome producing this disease lives as a harmless inhabitant of the blood of wild game and is conveyed from one animal to another by a biting fly, a tsetse. Previous to the introduction of domestic cattle into the cycle the importance of the trypanosome might well have been considered as negligible from an economic standpoint, but the fatal effects consequent upon the infection of domestic cattle place it immediately in the first rank of importance.

Such is a more or less simple case, in which the factors are fairly well known, but our ignorance of many tropical diseases is profound: in some we know neither the carrier nor the reservoir with any certainty. Our outlook when embarking upon investigations into such obscure diseases is often too limited and is biased by an expectation of similarity between known methods of disease transmission and those which have still to be discovered. Recent discoveries in various fields seem, when correlated with each other, to offer new suggestions for lines of investigation. We may have to look much further among invertebrates and even in the plant kingdom for reservoirs, especially of some human diseases. Also in searching for the vectors of disease we ought not to confine our attention solely to blood-sucking insects, &c., but plant-bugs and even still less obvious creatures cannot be passed over without suspect and careful examination.

The following results of recent researches indicate the possibilities in regard to this point of view.

In 1910 Lafont showed that a certain Protozoan, *Leptomonas davidi*, nearly allied to the trypanosomes, produced a diseased condition in plants belonging to the genus *Euphorbia*. The micro-organisms lived freely in the latex of the plant and were transferred from one plant to another by a bug *Nysius euphorbiae*. Protozoa of the genus *Leptomonas* are almost exclusively insect in origin, although some have been shown to be pathogenic to vertebrates. Since Lafont's discovery other similar Protozoa have been recorded from plants, but especially from the Euphorbiaceae.

In 1922 Franchini succeeded in inoculating two plants of *Euphorbia ipecacuanha* with the organisms of Kala-azar, the well-known oriental fever. The parasites appeared in the latex of the plants fifteen to twenty days after inoculation and they gradually increased in numbers until they were finally numerous. The plants turned yellow and most of the leaves fell; growth was arrested and other obvious symptoms of disease manifested themselves. The organisms could still be detected in the plants after three months. It is therefore clear that at least one human disease, Kala-azar, can thrive within a plant.

Franchini was able to infect other plants with species of *Herpetomonas*, trypanosome-like organisms often found in the alimentary canal of insects.

Paillot (1923) described a new Protozoan, *Herpetomonas* (*Leptomonas*) *chatoni* in the blood of a large number of caterpillars of the moth *Agrotis pronuba*, the infestation being of a benign character and never causing death. These organisms had apparently been introduced during egg-laying by an Ichneumonid, *Amblyteles armatorius*. All caterpillars infected with *Herpetomonas* also harboured larvae of the parasite *Amblyteles*. Two points are of outstanding interest here. Firstly that an Ichneumonid can probably transmit Herpetomonads and secondly that Herpetomonads may occur in the blood as well as in the alimentary canal of insects.

Several insect-feeding bugs, *e.g.*, Reduviids and Anthocorids, will attack man upon occasions. One has only to instance the "Kissing-bug" scare which swept over the United States some time ago and for which one or more Reduviids were probably responsible. The bugs developed the peculiar habit of biting the lips or cheeks of their human victims. It is therefore quite possible that organisms normally infecting insects can occasionally be transmitted to human beings by such insect-feeding bugs as those mentioned above, and although no Herpetomonad infecting insects has been shewn to be normally pathogenic to man yet such is well within the bounds of possibility.

Again, plant-bugs are known sometimes to attack man. We have records from the Lygaeidae, Pyrrhocoridae, Coreidae and Capsidae, so that reservoirs of human disease could exist in the plant kingdom, although infrequently drawn upon.

In 1923 Blacklock recorded the case of a cotton-stainer, *Dysdercus superstitiosus*, sucking human blood. Cotton-stainers of course normally feed upon Malvaceous plants and for them to attack man is exceptional, nevertheless circumstances sometimes point to exceptional occurrences as originating disease epidemics, the very discontinuity of which suggests an unusual source. An organism introduced to a human system from another host, might, if successful in establishing itself under the new conditions, be then transferred from man to man more or less mechanically by some common insect parasite of man.

Blacklock dissected several of the cotton-stainers and found the alimentary canal to be infected with Herpetomonads, but he found none of these flagellates in the salivary glands. Also it does not at all follow that the flagellates were such as to produce disease in man, or that they could be injected by the bug while biting man. Many Protozoa of this type are known regularly to live in the alimentary tract of insects without apparent injury to their hosts.

In another plant-bug, *Leptoglossus membranaceus* Herpetomonads from the alimentary canal were observed by Miss Robertson (1912) to invade the salivary glands, so that they would probably be injected with saliva into a fresh plant on which the bug chanced to feed.

Research in the past two or three years has indicated certain other organisms called *Rickettsia* bodies as pathogenic to man. Thus *Rickettsia quintana* appears to be the causal organism of Trench fever; *Dermocentroxenus rickettsi* that of Rocky Mountain fever. Now the distribution of *Rickettsia* in insects and arachnids is peculiar. Most of these insects or arachnids suck mammalian blood, but there are two striking exceptions namely the Chrysopidae and Ichneumonidae. Rare cases are known of Chrysopid larvae sucking the blood of man when pressed by hunger, but of Ichneumonids never. Paillot's discovery in *Agrotis* is therefore of added interest in this connection.

Taking into consideration then all the evidence, we must admit that many of these cases which might be passed over as of purely scientific interest may really be of great importance to a wider public. Diseases which seem to be new are frequently appearing, *e.g.*, Trench fever during the Great War. Others may be new to man, but from our lack of knowledge and imperfect methods of diagnosis are assumed to be forms of well-known diseases. It is fully possible that some of these may be traced at length to totally unsuspected sources, as for example Kala-azar, which can live within a plant and could be transmitted by a plant-bug to man. Transmission from man to man might then be easily accomplished by such as the bed-bug.

C. L. WITHYCOMBE.

ROCKEFELLER FOUNDATION.

The recently issued annual Report of the Rockefeller Foundation, that great American institution for the betterment of mankind, established through the beneficence of Mr. John D. Rockefeller in 1913, marks further progress and increased activity in the control of those fatal or undermining diseases which especially characterize the warmer regions of the world.

Yellow fever, the most dreaded disease, carried by mosquitoes of the genus Stegomyia is now generally under control. Twenty-five years ago, in the Western Hemisphere from Brazil to Washington and on the west coast from Peru to Mexico, the ravages of Stegomyia were appalling. To-day the only infected areas appear to be Eastern Mexico and a narrow coastal zone in Eastern Brazil from Ceara to Bahia, although unceasing vigilance is still required to control the breeding place of this mosquito.

In August, 1921, there was a slight outbreak of yellow fever in British Honduras. The International Health Board was at once notified, and so rapid and effective were the measures taken for its control that the epidemic was definitely checked in Mid-November after twenty cases in all had appeared.

The campaign in Mexico has been so vigorously pressed that in 1922 there were only 41 cases reported, while the number in 1920 was 505, and in 1921, 115.

In Italy, Palestine and South America much has been done in an attempt to stamp out malaria, that disease being the outstanding health problem in Italy. This country with its marshes, canals and sluggish streams affords ideal conditions for the breeding of the Anopheles mosquito which carries the cause of this malady.

Besides the excellent results achieved in controlling and preventing the ravages of hookworm, yellow fever and malaria the Foundation continues to gives its help to the establishment of educational institutions for training men and women in the care of public health and principles of hygiene—factors of great importance in the prevention of tropical diseases, especially hookworm, which is spread through soil pollution.

In China the Foundation upkeeps a College of its own "The Peking Union Medical College," which not only trains students in Medicine, but also provides a valuable premedical course. Innumerable hospitals and training schools are maintained ($4,896,216 were expended in 1922 under this head alone).

During the year under review the Foundation assisted in rebuilding and re-organizing medical schools at Sao Paulo, Brazil, and Bangkok in Siam, and has supplied laboratory equipment to medical institutions in Austria, Czechslovakia, Hungary and Switzerland. This assistance, as a result of a recent survey of institutions in Europe undertaken in 1922 is being extended to Germany and Poland. Equipment of all kinds as well as stipends have been given to teachers and investigators of the Pasteur Institute of Paris and other European centres, while two million dollars have been given toward the site, building and equipment of a school if hygiene in London (opened in August 1923). Demonstrations in malaria control have been carried on in the Southern United States, Porto Rico, Nicaragua, Brazil, Palestine, Australia and the Philippines.

Amongst other features of the year may be mentioned the operations begun in Porto Rico in 1921 which have resulted in more than one thousand cures of uncinariasis a month.

The work to be done in India in connection with hookworm disease is immense. More than thirty-six million out of the forty million people in the Madras Presidency alone are infected. In time the Institution with the co-operation of the Indian Medical services hopes to effect a marked reduction.

EMPIRE COTTON.

The real value of the new quarterly journal launched by the Empire Cotton Growing Corporation is that it stands for something definite. That something is the generalization that cotton spinning and cotton growing are parts of one industry. The fundamental significance of this idea is as yet too faintly appreciated : it applies to other things than cotton : in it lies the germ of real Empire consolidation. Disintegrated, "The Empire Cotton Growing Review" has in its first number several good articles giving information, more particularly in connection with cotton in Tanganyika : it also has two important articles giving recognition. Both are obituary notices. The first by Dr. Lawrence Balls, F.R.S., concerns the late Mr. J. W. McConnel, whose personality and intelligence gave birth to the Empire Cotton growing and industrial research organization and movement. The second by Mr. L. H. Burd describes the remarkable work of the late Mr. William Robson in Montserrat. In every way "The Empire Cotton Growing Review" is to be welcomed and is naturally of special interest and importance to the Imperial College of Tropical Agriculture which is so closely associated with many of the Empire Cotton Growing Corporation's activities.

COLLEGE NEWS.

Sir Francis Watts and Staff Delegates to the Jamaica Conference returned to Trinidad in February.

The Hon. J. T. De la Mothe, Grenada representative on the Governing Body paid a visit to the College in February.

As a response to the first number, seventy annual subscriptions to the College Journal have been received and every mail brings in fresh additions. The Journal has a large exchange list with all parts of the world and it is hoped that the total distribution of the Journal by the end of the year will be at least 3,000 monthly, including the free (official) distribution.

Copies of the new Prospectus will be ready shortly. A large number are being sent for distribution at the British Empire Exhibition.

After the conclusion of the Jamaica Conference Sir Arthur Shipley and Mr. Algernon Aspinall, C.M.G., proceeded to New Orleans in connection with matters concerning sugar technology at this College. They were to proceed home to England *via* New York.

The Hon. W. G. Freeman, Director of Agriculture, Trinidad, and member of the College Executive Committee will proceed shortly to England on duty leave in connection with the British Empire Exhibition.

Mr. W. Nowell, Assistant Director of Agriculture, Trinidad, spent two weeks in Costa Rica in connection with bananas, on his way back from the Jamaica Conference.

The many tourists who have visited the College this season included Brigadier-General H. Clifton Brown until recently Member of Parliament. General Brown is a large English landowner and keen agriculturist and was much interested in the College.

Work will shortly be started in the matter of erecting the College Sugar Factory. The Engineer-in-charge is on his way from England.

Consideration is also being given to the much-needed provision of machinery and other appliances for training in the chemical technology of rubber, cacao and tea manufacture.

NOTES OF INTEREST.

In view of the favourable sugar situation there is likely to be greatly increased demand during the coming year for mill equipment and machinery especially in United States territories.

The shortage in this year's Mauritius sugar crop is due to large tracts of land having been left uncultivated on account of scarcity of labour.

Kenya and Uganda which hitherto imported 3,000 tons of sugar annually are to-day self-supporting and according to a report to "The Times" are likely to have a surplus for export in the future.

The commencement of the Cuban crop was delayed at the beginning of January by heavy rains but the net result will not be unfavourable. The present crop is estimated as likely to be between 3,600,000 and 3,775,000 short tons.

During 1923 the export of rubber from the Dutch East Indies increased by over 40 per cent. of the figure for the previous year. This was almost entirely due to the great increase in the exports of rubber from Borneo, Djambi and Palembang and the export of native produce.

The shortage of good quality Santos coffee seems to have been the dominating feature on the New York Market and one of the principal reasons for high prices, especially as mild coffees are not produced in sufficient quantities to fill the gap created by the lack of soft drinking Santos. An outstanding feature of the coffee situation in general appears to be the low visible supply for the world.

In regard to the consumption of tea during 1923 the United Kingdom came first with 400 million pounds, the United States of America second with 95 million pounds, Australasia third with 50 million pounds and Canada fourth with 38. Consumption in Russia is increasing fairly rapidly.

TREND OF THE MARKETS.

(*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London*).

SUGAR.—Cubas were offered at 7.28 duty paid, New York, on February 5, last. Subsequently there was a 12 point decline but prices continue high at this lower rate. Strong competition during the closing period of 1923 in both Europe and America and the small indicated carry over promises on the whole firm prices for sugar for the commencement of and throughout the year 1924. It is interesting to note the range of sugar prices in New York raw duty paid. At the end of January last year the price of Cubans cost and freight in New York was 3.25 cents; because of the realization in trade circles that the Cuban crop was going to be considerably short of early estimates the price started rapidly to rise and culminated in a maximum of 6.625 cents cost and freight for Cubas at the end of April. It will be instructive to compare corresponding changes at the present time.

COTTON.—During the middle of February Middling Upland declined from 19 cents in New York to near 18 cents. The trend during the last two months has been slightly downward.

CACAO.—A rise in Trinidad cacao took place in mid February from a previous level of 9 to 9½ cents New York. Accras have also shown a tendency to rise; 33/6 per cwt. in London beginning of February.

COFFEE.—Santos has for some months been rising steadily reaching 74 shillings a cwt. in London, beginning of February.

TEA.—The Indian average in February has been steady around 18 1/8 pence per lb., 1*d*. per lb. lower than last Autumn.

SISAL.—Good sisal is exceedingly firm at £40 a ton beginning of February, having risen steadily since November.

RUBBER.—Since the November-December revival the general tendency has been slightly downward, 1/2*d*. beginning of February. The English Dock and transport strike will increase consumption of rubber tyres.

RICE.—Burmese which rose at the beginning of December has continued steady at £17 10s. a ton.

COPRA.—Exceedingly firm, good copra quoted at £33 10*s*. per ton beginning of February. Trend since last August continuously and rapidly upwards.

VEGETABLE OILS.—The following approximate prices were ruling in Liverpool and London in February; castor oil £60 per ton; ground nut oil £51; coconut oil £50 (c.i.f.); palm oil (soft) £40; palm oil (hard) £39; palm kernels £21 (forward); palm kernel oil £44; cotton seed oil £50 per ton.

SPICES.—The 1923 range of prices for spices shows that pimento during 1923 was 5¼ cents compared with 4 5/8 in 1922; cloves 34 compared with 23 cents; West Indian nutmegs 23 compared with 15¾ cents; good Jamaican ginger 36 compared with 36½ and African ginger 15½ compared with 10½ cents in the previous year.

It is satisfactory to note in "The Australian Sugar Journal" recognition of the importance of "standards of production." In order to illustrate popular misconception in this matter, reference is made to the much-quoted statistics showing the greater yield of produce per acre in Germany as compared with Great Britain, and the consequent assumption of the relative inefficiency of the British farmer. Enquiry of course reveals the fact that though it is true Germany produces or used to produce about 50 per cent. more food from a square mile than does England, yet about twice the labour power is or was employed in Germany for the same area. The capital employed in each case is also an important standard for comparison. In regard to standards of production, the interests of the producer and of the nation do not necessarily coincide so far as the ideal standard of production is concerned. Intensive agriculture, for example, producing the highest possible yield per acre is more important in thickly populated countries than in countries where there is a superfluity of land; but the degree of intensity in the former circumstances may be limited by market prices.

The advertising propaganda to increase the consumption of Indian tea in the United States has received its final preparation and was launched on February 1 in New York, Boston and Philadelphia. The propaganda which is going to cost one million dollars is under the direction of Sir Charles F. Higham who proceeded from London to the United States as representative of the growers in India. The advertising will be concentrated in a different section of the country of the United States each year and will close with a national campaign. Although this constitutes a direct hit at coffee drinking in the States, the American press comments are very friendly and in some cases are not lacking in a tone of mild amusement.

The world's total production of cacao for 1920 is estimated at 370,900 metric tons, for 1921 at 387,300 tons and for 1922 at 389,300 tons, while the world's consumption for those years is estimated at 364,400 tons, 410,600 tons and 417,100 tons respectively.